

For Jeroen Groenendijk, Martin Stokhof and Frank Veltman

Hans Kamp

University of Stuttgart & University of Texas, Austin

1.

Dear Jeroen, Dear Martin, Dear Frank,

Where to start saying something about what the three of you have contributed to our field – ‘fields’ would perhaps be better, but I won’t try to distinguish between logic, philosophy, linguistics and cognitive and computer science – and where to end? Clearly, there is so much that really ought to be taken up on an occasion like this. Far, far too much – even if the number of minutes for this address were turned into the same number of hours.

So I have decided to focus on just one of your many gifts to our scientific world - one that is associated with the names of all three of you. This is your way of thinking about, and formally treating, the complex of issues that are now usually referred to, with some foreshortening perhaps, as ‘Dynamic Semantics’. In one sense, this is, I think, not quite the right term for what you have achieved. For though Dynamic *Semantics* is definitely a crucial part of that achievement, the achievement goes well beyond that. And I think the world at large is at last waking up to that.

Nevertheless, much of what I will say here is about ‘Dynamic Semantics’ in the more specific sense of something that is about meaning, and, even more specifically, about meaning in the languages we speak. I will focus on meaning in the modern Lingua Franca in which this address is stated, but the points are general; the few English examples I will mention can be translated without loss into many other languages (including our own language, Dutch).

I want to kick off with a couple of such examples. The first I got from Barbara Partee, and the second is (to the best of my knowledge) my own.¹

- (1) a. One of the ten marbles is not in the bag.
It is under the sofa.
- b. Nine of the ten marbles are in the bag.
It is under the sofa.
- (2) a. Half of the shareholders failed to turn up at the annual meeting.
They couldn’t vote but learned about the results the next morning.
- b. Half of the shareholders came to the annual meeting. **They** couldn’t vote but learned about the results the next morning.

In the first example of the first pair (i.e. in (1-a)) the pronoun *it* can be interpreted straightforwardly as referring to the missing ball. In the second example (1-b) such an interpretation

¹Barbara gave me her example, in the spring of 1980 – her immediate reaction to my mentioning the second example to her; it was clear that she had been thinking about this problem for some time, and she has confirmed to me that this example came up in an earlier conversation with Irene Heim.

of the pronoun is difficult to get (and in certain contexts impossible). And on the face of it this is a puzzle: The first sentence of (1-a) and the first sentence of (1-b) have the same truth conditions – they ‘express the same proposition’ as many people would put it. Moreover, the second sentences of (1-a) and (1-b) are identical. So if the first two sentences express the same proposition and the second sentences act as ‘update operations’ on this proposition then, since the second sentences are the same, then in each of the two cases the outcomes should be the same as well. But we have just seen that they aren’t.

The story about the second sentence pair is much the same: in (2-a) the pronoun *they* can refer to the half of the shareholders that were not at the meeting; in (2-b) it cannot.

Apparently anaphoric pronouns, singular or plural, show a strong preference for referring to items that have been mentioned in the discourse, and not to items ‘left over’ as differentials between what was mentioned explicitly. But that is distinction that truth conditions do not capture.

This is just a negative conclusion: If we identify that which can be ‘updated’ (amplified, added onto) by subsequent sentences with the propositions expressed by sentences – in that sense of ‘proposition’ according to which propositions are nothing but reified truth conditions – then there is no way to account for the difference between (1-a) and (1-b) and, likewise, for that between (2-a) and (2-b). But what are we to do about this?

Simplifying somewhat, there have been two clearly distinguishable ‘dynamic’ responses to this puzzle.² One of them is in a way quite old-fashioned. It is a *representational* approach.³ It is superficially reminiscent of a similar response to certain puzzles about belief attribution: Given that *Cicero* and *Tully* are names for the same man, ((3).a) and ((3).b) would, on most semantic accounts, express the same proposition.

- (3) a. Cicero was a member of the Roman Senate some time during the 1st Century BC.
 b. Tully was a member of the Roman Senate some time during the 1st Century BC.

This entails that if belief is a *propositional* operator or predicate, then ((4).a) and ((4).b) would have to have the same truth conditions, and therefore, in relation to the same concrete situation, always the same truth values.

²The story I am telling here is seriously incomplete. Problems like the pronoun interpretations in (1) and (2) have also been approached in a quite different way. A central tenet of this alternative approach is that the second sentences in (1) and (2), while looking identical, are in fact different. This is because the anaphoric pronouns they contain are ‘dummies,’ which stand in for certain definite descriptions that can be identified only within the context in which the pronoun appears; and this context may extend beyond the sentence containing the pronoun (as it does in (1) and (2), where the first sentence is the crucial part of the context for the pronoun in the second). Originally this approach, which goes back to a time before the advent of the dynamic approaches I am talking about here, was associated primarily with the names of Gareth Evans and Robin Cooper and generally known as the ‘E-type pronoun’ account (Evans (1980), Evans (1977), Cooper (1979)). The most popular version of this approach today would appear to be the so-called ‘D-type’ treatments (Neale (1990), Heim (1990), Elbourne (2005)). These last treatments share with the E-type theories the assumption that anaphoric pronouns are abbreviations of definite descriptions, but in addition they also adopt a different notion of propositional content, based on *situations* instead of possible worlds. (N.B. this is a very different revision of the notion of propositional content from the dynamic notion described below.)

³Kamp (1981). The theory developed in Heim (1988) makes the same predictions as about interpretability and truth conditions for that part of English that is within the scope of both theories – Heim’s is about definite noun phrases in general and has a wider coverage than Kamp (1981) – but Heim’s theory is not representational in the specific way of Kamp (1981) and has closer affinity with the Dynamic Semantics described below.

- (4) a. A believes that Cicero was a member of the Roman Senate some time during the 1st Century BC.
 b. A believes that Tully was a member of the Roman Senate some time during the 1st Century BC.

But it seems intuitively possible that one of these belief attributions is true while the other is false. For A may not realise that Tully and Cicero are one and the same man, so what he believes about, say, Cicero won't automatically register as a 'Tully-belief' (and conversely).

One reaction to such examples is to say that belief and other attitudinal notions are sensitive to the way in which their argument – a proposition – is presented or represented: under one (re-)presentation the proposition is recognised by A as one to which he has a definite attitude (in this case: that of belief) and under the other (re-)presentation it is not so recognised.

But what kind of solution is this? Are we now to see belief and its ilk as relations to propositional representations, or 'guises'? Or is belief a 3-place relation between agents, propositions and (re-)presentations? And is there any substantive difference between these options? What more is there to this 'solution' than a restatement the original problem in different terms?

In fairness, the 'representational' solution that was proposed for the problem presented by (1) and (2) isn't open to quite this objection, since that proposal included a quite specific proposal about the form of the propositional representations involved, and it exploits specific features of representational forms it postulates in the way it states the interpretation rules of anaphoric pronouns in subsequent sentences. But nevertheless, not all properties of the postulated representations are reflected in those rules and that alone should be a reason to try and figure out *precisely what* it is that is missing from the 'classical' conception of a proposition referred to above and that is capable of driving a wedge between the interpretations of the second sentences in the (a)-versions and the (b)-versions of (1) and (2). What could be the semantic entities which are determined by sentences such as the first sentences of the sentence pairs in (1) and (2) and which differ in a way that accounts for the differences between the (a)-cases and the (b)-cases?

When one reflects on the semantic contributions made by the first sentences in (1) and (2) from this point of view, then reflecting on the contributions that are made by the second sentences of these little discourses becomes inevitable as well. As the discussion has suggested, these second sentences should be regarded, from the present formal perspective as *operators*, or *functors*, which turn the information provided by the first sentences into the information provided by first and second sentences together.⁴

It is through the pursuit of these questions that the *Dynamic Semantics* came about which the world owes to you. Let me briefly summarise, in terms that I hope will be accessible to most of us here, what the central elements are of this new way of thinking about information and meaning.

⁴There is a long list of relevant publications that could and should be mentioned here. But this is an address, not a scientific study, so I will just give references to the two most famous papers on this topic by Martin and Jeroen and two from the three of you: Groenendijk and Stokhof (1991), Groenendijk and Stokhof (1990), Groenendijk *et al.* (1996a), Groenendijk *et al.* (1996b).

STATIC SEMANTICS

DYNAMIC SEMANTICS

sentence meaning	proposition: set of possible worlds	context change potential (ccp): a function from information states to information states
		derivatively, in some but not all cases: an information state.

1. Propositions – that is, sets of possible worlds $\{w_1, w_2, w_3, \dots\}$ – are replaced by *information states*: tuples consisting of a world and one or more individuals (which identify certain ‘participants in the event or situation described’): $\{\langle w_1, d_1 \rangle, \langle w_1, d_2 \rangle, \langle w_2, d_2 \rangle, \langle w_3, d_3 \rangle, \dots\}$

2. The meaning of a complete sentence is now no longer a classical proposition. But in general it isn’t an information state either. Rather, it is a function from information states to information states, a so-called *context change potential* or *ccp*. Derivatively, some sentences also denote information states – those information states that are obtained when the ccp of the sentence is applied to the ‘empty’ information state Λ , which contains no information whatever. (Only for some sentences is an application of their ccp to Λ well-defined. These are the sentences that can ‘stand on their own’ when it comes to the expression of a well-defined propositional content.)

Once we think of the semantic role of sentences in a discourse or text along these lines – of each new sentence as taking the information state thus far obtained as input and transforming it into a new, typically more informative, information state – then a number of the central concepts of classical semantics have to be rethought and redefined as well.

First, there is the notion of truth. A classical proposition p is true in a world w if and only if w is one of the worlds belonging to p – saying in which worlds it is true and in which it is false is all that a classical proposition does. But what can the notion of truth be applicable to now that the classical notion of a proposition has been abandoned? Here is the intuitively natural answer: Information states tell us in which words they are realised, – or with which worlds they are ‘compatible’, if you prefer. (Technically these are the worlds that occur as first member in some tuple belonging to the information state.) So, there is a sense in which an information state is ‘true’ in just those worlds that it contains as first member of some tuple. Or, to put the matter in slightly different terms: each information state I determines a classical proposition p_I , which consists of all those worlds that appear as first members of tuples in I . An information state I is ‘true’ in w if p_I is true in w .

A second, more dramatic rethinking is called for in relation to the notions of *inference* and *entailment*. In Static Semantics the natural, and standard, way of defining entailment is as preservation of truth:

A entails B if in all models (and all worlds of those models), if A is true in such a model (at such a world), then so is B .

But when semantics is rethought along dynamic lines, then this is no longer the only natural option, and in fact it is no longer the most natural one. For on the new conception truth is, you might say, somewhat sidelined; the real ‘action’ is in the presentation, transmission and

incrementation of information. When we think about entailment from this perspective, it is natural to see what is entailed by a given quantity of information as that which has no information that goes beyond the given quantity, and which thus will not lead to any increase of information when it is added to that given quantity. So we come to the schematic definition:

(5) A entails B iff updating A with B returns A .

It may not be immediately clear how this schematic definition can be made operational. As this is not the occasion for going into technical details, I'll permit myself just one remark. We can apply the schematic definition in particular to sentences of our natural language; and here we can exploit the fact that on the dynamic conception sentence meaning can manifest itself at two distinct levels – as ccps and as information states. Suppose that A is a sentence that determines an information state as well as a ccp and that B determines at least a ccp (as all sentences are assumed to do). Then (5) has a straightforward interpretation:

A entails B if the information state determined by A remains the same when the ccp of B is applied to A .

The Dynamic perspective I am sketching has proved particularly fruitful because of what it enables us to say about the relations between meaning, information and inference. One direction, the importance of which has come only gradually into focus – this, I confess with some embarrassment, has been true for me personally, but I think this has been true more generally – is the role of information states in communication. To give just one example: Pretty much every statement we make is accompanied by the consideration: Is this a piece of information that is not yet part of the information state of my addressee? But there are also all sorts of other ways in which language relates to the information states of particular agents – or of groups of agents, or of the community at large. And what is more (though not surprising), the languages we speak are full of devices that refer or relate to our own information states or to those of our interlocutors. One important category of such devices are the epistemic modals. In fact, it seems that by far the most common use that we make of modal expressions and constructions is as epistemic modals. And a classical example of what dynamic semantics has to say about epistemic modals is what it has to say about the modal auxiliary *might*.⁵

One of the important insights of the new, ‘dynamic’ way of thinking about semantics I am talking about has been that certain words have the function of relating what is stated in the sentence of which they are part to the information state of the speaker (or to an information state that is not just the speaker’s, but with which the speaker sees herself is associated in some way). Thus when A says

(6) It might be raining.

then that is as a rule to be taken as a statement to the effect that the content of ‘It is raining’ is compatible with the current information state of the speaker A . In a sense it is a statement ‘about’ A ’s information state; it says about it that it doesn’t contain information with which ‘It is raining’ is incompatible. And it is in this sense that a statement like (6) can be informative: It tells you something about limits to the information state of the one who says it: that

⁵The perhaps most widely known paper in which this seminal proposal about the dynamic treatment of *might* and other epistemic modals was first presented I take to be Veltman (1996).

information state does *not* contain information which rules out the possibility that it is now raining.

That information states – those of others no less than our own – are an important part of our knowledge and that we rely on what we know about them in even the most mundane situations must be an age-old observation, and it is certainly one that is very common place. What is not always all that obvious is where and how such knowledge is relevant and where and how it is used. There are some disciplines for which the role of information, and the lack thereof, in the context of human action and interaction is the very topic. Game Theory is perhaps the discipline that comes to mind first. But many of the logics of knowledge and action – another Amsterdam specialty - deal with this topic as well. Dynamic Semantics, in the form in which the three of you have been at the forefront of developing it, is yet another approach to aspects of this very large topic. And I'd like to stress in this connection, returning to a hint I made at the beginning, that it does *more* than what its name – ‘Dynamic *Semantics*’ – first and foremost suggests: The central new concepts of Dynamic Semantics are not just about meaning and content in the languages which we speak. They can be applied to information and information update more generally. And from this angle Dynamic Semantics is an integral part of the role of information in human action and interaction in general, whether language is involved or isn't.

To have a range of perspectives on the study of information and action, with new concepts and new effective technical tools to explore local and global issues, is arguably the single greatest gift of Amsterdam's group of logicians, philosophers and computer scientists to the rest of the world. Dynamic Semantics - YOUR Dynamic Semantics! – is an essential part of that gift. It is that in part because of what it has to tell us about the way information is handled in human language. But only in part. It is that also because you saw that what may have impressed itself on many of us as ‘just’ a linguistic problem is at heart a deeper and more general one. And you have not only made clear what that deeper problem is, but have also given us the conceptual and formal means with which to tackle it.

This has been only one of the different things that, jointly or on your own, the three of you have bequeathed upon the world. But that is all there was time for. In choosing this topic I have not only been guided by the idea that this is something that concerns all three of you. It is also because it is a topic that is of truly major importance and that, I believe, is only now gradually having the impact and getting the recognition that it deserves. That has taken a rather long time – longer than I think many of us had expected. But the signs are now clearly there, especially within analytic philosophy.

Such delays are perhaps inevitable when novel ideas come hand in hand with a new formal framework. It often takes a new generation of scientists, who familiarise themselves with the new framework early on, so that they can use it – perhaps cannot help using it – when looking for solutions to *their* problems – some of them old ones that are still without a satisfactory solution, but also new ones, among them many that only a new dynamic framework enables us to see in their colours.

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